HANDWRITTEN DIGIT DETECTION IN DEEP LEARNING USING PYTHON PROGRAMMING

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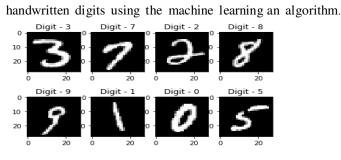
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Abstract –As we know that the hand written digit recognition based applications includes in a bank purpose used i.e. a deposit, withdraw and another check clearance process, a post office related work, and data an entry form, etc. our aim to improve the ability to develop the system and increased an efficient algorithm that can recognize handwritten digits and which is submitted by users by the way of their mobile phones, a scanner, a tablet, and other digital devices. In this paper we will try to present an approach to off-line handwritten digit recognition based on different-different machine learning a technique. In this paper our focus to present to handwritten digit recognition related an algorithm with the help of the python programming because of the evolution of a varied Machine Learning, Deep Learning and Computer Vision algorithms. In this research paper, I compare the results of some other used Machine Learning Algorithms like KNN, SVM & RFC and with Deep Learning algorithm like multilayer CNN using Keras with Theano and Tensorflow. Our aim is providing the higher accuracy with the high efficiency.

Key Words: Pattern recognition, handwritten recognition, digit recognition, machine learning, Deep Learning, Python.

1.INTRODUCTION

Handwritten character recognition is one among of the practically important issues in pattern recognition applications. The applications include in a bank purpose used i.e. a deposit, withdraw and another check clearance process, a post office related work, and data an entry form, etc. The heart of the matter lies within the ability to develop an efficient algorithm that can recognize handwritten digits and which is submitted by users by the way of a scanner, a tablet, and other digital devices. In this project we are going to recognize the handwritten digits using the machine learning an algorithm.

Digit recognition is one among of the active research topics in digital image processing. It is a classic machine learning problem. The goal of this project is to require a picture of handwritten digits and determine what those digits are. The rapid climb of the latest documents and multimedia news has created new challenges in pattern recognition and machine learning. Handwriting character recognition has become a standard research area due to advances in technologies such as the handwriting capture devices and powerful mobile computers. However, since handwriting very much depends on the writer, building a high-reliability recognition system that recognizes any handwritten character input to an application, is challenging. This work considers the matter of recognizing handwritten digits, i.e. numbers from 0 to 9. Typically, handwritten digit recognition is an essential function in a variety of practical applications, for example in administration and finance. The handwritten digit recognition is the ability of computers to recognize human handwritten digits. It is a tough task for the machine because handwritten digits aren't perfect and may be made with many various flavors. The handwritten digit recognition is the solution to this problem which uses the image of a digit and recognizes the digit present in the image. To develop the software we have used Tkinter for creating the GUI. Tkinter may be a Python binding to the Tk GUI toolkit. It is the quality Python interface to the Tk GUI toolkit, and is Python's de facto standard GUI. Tkinter is included with standard Linux, Microsoft Windows and Mac OS X installs of Python. The name Tkinter comes from Tkinter interface. It can be more user-friendly and provide accuracy more than existing ones.

2.MACHINE LEARNING

Machine learning teaches computers to do what comes naturally to humans and animals: learn from experience. Machine learning algorithms use computational methods to "learn" information directly from data without relying on a predetermined equation as a model. The algorithms adaptively improve their performance as the number of samples available for learning increases.

REAL-WORLD APPLICATIONS

With the rise in big data, machine learning has become particularly important for solving problems in areas like these:
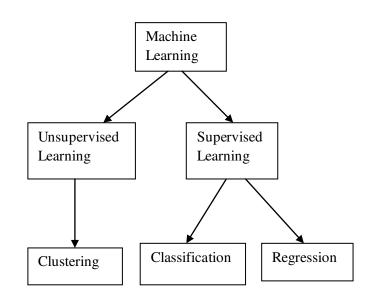
• Computational finance, for credit scoring and algorithmic trading

• Image processing and computer vision, for face recognition, motion detection, and object or diseases detection

• Computational biology, for tumor detection, drug discovery, and DNA sequencing

• Energy production, for price and load forecasting • Automotive, aerospace, and manufacturing, for predictive maintenance

• Natural language processing

HOW MACHINE LEARNING WORKS

Machine learning uses two types of techniques: supervised learning, which trains a model on known input and output data so that it can predict future outputs, and unsupervised learning, which finds hidden patterns or intrinsic structures in input data.

Machine Translation(MT)

Machine translation (MT) is the application of computers to the task of translating texts from one natural language to another. One of the very earliest pursuits in computer science, MT has proved to be an elusive goal, but today a number of systems are available which produce output which, if not perfect, is of sufficient quality to be useful for certain specific applications, usually in the domain of technical documentation. In addition, translation software packages which are designed primarily to assist the human translator in the production of translations are enjoying increasingly popularity within professional translation organizations.

Comprehending the enormous complexity of translating human language and the inherent limitations of the current generation of translation programs is essential to understanding MT today. MT systems are designed according to one of the following parameters: coverage and Reliability. An MT system can either be designed to reproduce for a small language segment i.e. a sub-language or a controlled language with high fidelity and precision or it may be designed to perform informative, general purpose translations. In the former case, the system will have high reliability, whereas in the latter case, its coverage will be high.

However, both properties are, to a certain extent, mutually exclusive.

- Coverage refers to the extent to which a great variety of source language texts can successfully be translated into the target language. A successful translation can be described as to be informative in the sense that allows a user to understand more or less the content of the source text.
- Reliability refers to the extent to which an MT system approaches an "ideal" translation (of a restricted domain) for a given purpose or for a given user. A reliable translation is user-oriented and correct with respect to text type, terminological preferences, personal style, etc.

Deep Learning: Deep Learning is a subfield of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks.

3. RESEARCH AND METHODOLOGY:

a) Multilayer Perceptions: A neural network based classifier, called Multi Layer perception (MLP), is employed to classify the handwritten digits. Multilayer perceptron consists of three different layers, input layer, hidden layer and

output layer. Each of the layers can have the certain number of nodes also called neurons and each node in a layer is connected to all other nodes to the next layer [12]. For this reason it's referred to as feed forward network. The number of nodes within the input layer relies on the amount of apparent classes exist within the dataset. The convenient number of hidden layers or the convenient number of nodes during a hidden layer for a selected problem is tough to work out. But in general, these numbers are selected experimentally. In multilayer perceptron, the connection between two nodes consists of a weight. During training process, it basically learns the accurate weight adjustment which is corresponds to every connection [13]. For the training purpose, it uses a supervised learning technique named as back propagation algorithm.

b) Support Vector Machine: SVM or Support Vector Machine is a specific type of supervised ML method that intents to classify the data points by maximizing the margin among classes in a high-dimensional space [14]. SVM is a representation of examples as points in space, mapped due to the examples of the separate classes are divided by a fair gap that is as extensive as possible. After that new examples are mapped into that very same space and anticipated to reside to a category supported which side of the gap they fall on [15]. The optimum algorithm is developed through a "training" introduce which training data are adopted to develop an algorithm capable to discriminate between groups earlier defined by the operator (e.g. patients vs. controls), and therefore the "testing" introduce in which the algorithm is adopted to blind-predict the group to which a replacement perception belongs [16]. It also provides a very accurate classification performance over the training records and produces enough search space for the accurate classification of future data parameters. Hence, it always ensures a series of parameter combinations now but on a wise subset of the info. In SVM it's better to scale the info always; because it'll extremely improve the results. Therefore, take care with big dataset, because it may result in the rise with in the straining time.

c) Random Forest Algorithm: Random forest as is an ensemble of pruned regression or classification trees, activated from bootstrap samples of the training data, adopting random feature selection in the tree imitation process. The prediction is made by accumulating the predictions of the ensemble by superiority voting for classification. It returns generalization error rate and is more potent to noise. Still, almost like most classifiers, RF can also suffer from the curse of learning from an intensely imbalanced training data set. Since it is constructed to mitigate the overall error rate, it will tend to focus more on the prediction efficiency of the majority class, which repeatedly results in poor accuracy for the minority class.

d) Naive Bayes: The Naive Bayes classifier [19] contributes an easy method, representing and learning probabilistic knowledge with clear semantics. It is termed naive due to it relies on two important simplifying assumes that predictive attributes are conditionally self-reliant given the class, and it considers that no hidden attributes influence the prediction method. It is a probabilistic classifier which relies upon Bayes theorem with robust and naive independence assumptions. It is one of the best basic text classification approaches with numerous applications in personal email sorting, email spam detection, sexually explicit content detection, document categorization, sentiment detection, language detection [20]. Although the naive design and over simplified assumptions that this approach uses, Naive Bayes accomplishes well in many complicated real-world problems. Although it's often outperformed by other approaches like boosted trees, Max Entropy, Support Vector Machines, random forests etc. Naive Bayes classifier is extremely potent as it is less computationally intensive (in both memory and CPU) and it needs a small extent of training data. Moreover, the training time with Naive Bayes is considerably smaller than against alternative approaches.

4. EXPERIMENTAL TOOLS

Waikato Environment for Knowledge Analysis (WEKA) is a most convenient method of machine learning which is written in Java and developed at the University of Waikato. It is free software under the GNU. It contains a collection of algorithms and visualization tools for a predictive modeling, data analysis, along with a graphical user interfaces for smooth access to this functionality [30]. It supports various standard data mining tasks, more particularly, data pre-processing, a classification, a visualization, a clustering, feature selection, a regression. All of Weka's approaches are predicated on the assumption that the data is convenient as a single flat file or a relation, where each data point is characterized through fixed a number of attributes [31]. WEKA has numerous user has interfaced. Its main user interface is the Explorer, however essentially the same functionality can be accessed by the component based Knowledge Flow interface and from the command line.

5. CONCLUSIONS

The main objective of this research paper is to find a representation of algorithm of handwritten digits that allows their effective recognition techniques. In this paper used different machine learning algorithm for recognition of handwritten numerals (Digits 0 to 9). The proposed algorithm tries to deal with both the factors and well in terms of increased accuracy and time complexity. The overall highest accuracy 93.37% is achieved in the recognition process by Multilayer Perceptron. This work is carried out as an initial attempt, and the aim of the research paper is to facilitate for recognition of handwritten numeral and achieved the highest accuracy 99.50 % without using any standard classification

techniques 99.50 % without using any standard classification techniques.

6. ACKNOWLEDGMENT

REFERENCES

[1]A. Dutta and A. Dutta, Handwritten digit recognition using deep learning, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), vol. 6, no. 7, July 2017.

[2]https://globaljournals.org/GJCST_Volume18/3-Handwritten-Digit-Recognition

[3]A. Talwar and Y. Kumar, "Machine Learning: An artificial intelligence methodology," Int. J. Eng. Comput. Sci., vol. 2

[4]https://www.researchgate.net/publication/326408524_Handwritten_Digit_Recognition_using_Machine_Learning_Algorithms

[5]Watada, J., & Pedrycz, W. A fuzzy regression approach to acquisition of linguistic rules. Handbook of Granular Computing, 719-732, 2008.

[6]Seewald, A. K. (2011). On the brittleness of handwritten digit recognition models. ISRN Machine Vision, 2012.

[7] Kloesgen, W., & Zytkow, J. Handbook of Knowledge Discovery and Data Mining.

[8] Das, N., Sarkar, R., Basu, S., Kundu, M., Nasipuri, M., & Basu, D. K. A genetic algorithm based region sampling for selection of local features in handwritten digit recognition application. Applied Soft Computing, 12(5), 1592-1606, 2012.

[9]Plamondon, R., & Srihari, S. N. Online and off-line handwriting recognition: a comprehensive survey. IEEE Transactions on Pattern Analysis and Machine Intelligence, 22(1), 63-84.

[10]AlKhateeb, J. H., Pauplin, O., Ren, J., & Jiang, J.. Performance of hidden Markov model and dynamic Bayesian network classifiers on handwritten Arabic word recognition. knowledge-based systems, 24(5), 680-688, 2011.

[11]Tokas, R., & Bhadu, A. A comparative analysis of feature extraction techniques for handwritten character recognition. International Journal of Advanced Technology & Engineering Research, 2(4), 215-219, 2012

[12]Neves, R. F., Alberto Filho, N. G., Mello, C. A., & Zanchettin, C. A SVM based off-line handwritten digit recognizer. In System, IEEE International Conference on Man, and Cybernetics (SMC) (pp. 510-515), 2011.

[13]Perwej, Y., & Chaturvedi, A. Machine recognition of hand written characters using neural networks. arXiv preprint arXiv:1205.3964, 2012.

[14]Liu, C. L., Nakashima, K., Sako, H., & Fujisawa, H. Handwritten digit recognition: benchmarking of state-of-the-art techniques. Pattern Recognition, 36(10), 2271-2285.

[15] LeCun, Y., Bottou, L., Bengio, Y., & Haffner, P. (1998). Gradient-based learning applied to document recognition. Proceedings of the IEEE, 86(11), 2278-2324.

[16] Bhowmik, S., Roushan, M. G., Sarkar, R., Nasipuri, M., Polley, S., & Malakar, S. Handwritten Bangla Word Recognition Using HOG Descriptor. In 2014 Fourth International Conference of Emerging Applications of Information Technology (EAIT), (pp. 193-197). IEEE, 2014.

[17]Kruse, R., Borgelt, C., Klawonn, F., Moewes, C., Steinbrecher, M., & Held, P. Multi-Layer Perceptrons. In Computational Intelligence (pp. 47- 81). Springer London, 2013.

[18] Pereira, F., Mitchell, T., & Botvinick, M. Machine learning classifiers and fMRI: a tutorial overview. Neuroimage, 45(1), S199-S209, 2009.

[19]Support Vector Machine, Online: https://en.wikipedia.org/wiki/Support_vector_machine, Accessed, August 2015.

[20] Orrù, G., Pettersson-Yeo, W., Marquand, A. F., Sartori, G., & Mechelli, A. Using support vector machine to identify imaging biomarkers of neurological and psychiatric disease: a critical review. Neuroscience & Biobehavioral Reviews, 36(4), 1140-1152, 2012.

[21] Cooper, G. F., & Herskovits, E. A Bayesian method for constructing Bayesian belief networks from databases. In Proceedings of the Seventh conference on Uncertainty in Artificial Intelligence (pp. 86-94). Morgan Kaufmann Publishers Inc.

[22] Salzberg, S. L. C4. 5: Programs for machine learning by j. ross quinlan. morgan kaufmann publishers, inc., 1993. Machine Learning, 16(3), 235-240.

[23] John, G. H., & Langley, P. Estimating continuous distributions in Bayesian classifiers. In Proceedings of the Eleventh conference on Uncertainty in artificial intelligence (pp. 338-345). Morgan Kaufmann Publishers Inc.

[24] Nguyen, H. A., & Choi, D. Application of data mining to network intrusion detection: classifier selection model. In Challenges for Next Generation Network Handwritten Digit Recognition using Machine Learning Algorithms © 2018 Global Journals Global Journal of Computer Science and Technology Volume XVIII Issue I Version I 22Year 2018 ( ) D Operations and Service Management (pp. 399-408). Springer Berlin Heidelberg, 2008.

[25] Bin Othman, M. F., & Yau, T. M. S. Comparison of different classification techniques using WEKA for breast cancer. In 3rd Kuala Lumpur International Conference on Biomedical Engineering 2006 (pp. 520-523). Springer Berlin Heidelberg.

[26] Bouckaert, R. R. Properties of Bayesian belief network learning algorithms. In Proceedings of the Tenth international conference on Uncertainty in artificial intelligence (pp. 102-109). Morgan Kaufmann Publishers Inc.

[27] Buntine, W. Theory refinement on Bayesian networks. In Proceedings of the Seventh conference on Uncertainty in Artificial Intelligence(pp. 52-60). Morgan Kaufmann Publishers Inc.

[28] Random trees, Online: http://docs.opencv.org/modules/ml/doc/random_trees.html, Accessed, August 2015.

[29] Trier, Ø. D., Jain, A. K., & Taxt, T. Feature extraction methods for character recognition-a survey. Pattern recognition, 29(4), 641-662.

[30] Koerich, A. L., Sabourin, R., & Suen, C. Y. Large vocabulary off-line handwriting recognition: A survey. Pattern Analysis & Applications, 6(2), 97-121.

[31] Rahman, A. F. R., Rahman, R., & Fairhurst, M. C. Recognition of handwritten Bengali characters: a novel multistage approach. Pattern Recognition, 35(5), 997-1006.

[32] Chandrasekaran, R., Chandrasekaran, M., & Siromoney, G. Computer recognition of Tamil, Malayalam and Devanagari characters. Journal of the Institution of Electronics and Telecommunication Engineers, 30(6), 150-154. 29. Seewald, A. K. Digits-a dataset for handwritten digit recognition.Austrian Research Institut for Artificial Intelligence Technical Report, Vienna (Austria).

[33] Weka Software Documentation, Online: http://www.cs.waikato.ac.nz/ml/weka/,accessed, August 2015.

[34] Weka (Machine Learning)Online: https://en.wikipedia.org/wiki/Weka_(machine_learning), accessed, August 2015.

[35] Le, Q. V. (2013, May). Building high-level features using large scale unsupervised learning. In 2013 IEEE international conference on acoustics, speech and signal processing (pp. 8595-8598). IEEE.

[36] Ciregan, D., Meier, U., & Schmidhuber, J. (2012, June). Multi-column deep neural networks for image classification. IEEE Conference on Computer Vision and Pattern Recognition (CVPR), (pp. 3642-3649). IEEE.

[37] Schmidhuber, J. (2015). Deep learning in neural networks: An overview. Neural Networks, 61, 85-117. Elsevier.

[38] Das, N., Pramanik, S., Basu, S., Saha, P. K., Sarkar, R., Kundu, M., & Nasipuri, M. (2014). Recognition of handwritten Bangla basic characters and digits using convex hull based feature set. arXiv preprint arXiv:1410.0478.

[39]Liu, C. L., Yin, F., Wang, D. H., & Wang, Q. F. (2013). Online and offline handwritten Chinese character recognition: benchmarking on new databases. Pattern Recognition, 46(1), 155-162.